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Income Inequality in Norway, 1960-2011

Analyzing top income shares in relation to the inverted Pareto-Lorenz and Gini coefficient

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Abstract: Over the last decades, the share of income accruing to upper income groups and the overall inequality has increased in many developed countries. This thesis primary objective has been to analyse whether there is a cointegration between Norwegian top income shares and the inverted Pareto-Lorenz coefficient. If a cointegration relationship is found it means that the top income shares could be used as a proxy of inequality. The secondary objective was to investigate how the top income shares, along with the Gini coefficient evolved during the banking crisis in 1991-1992 and the recent financial crisis. The data used was derived from the World Income Inequality Database v.2 (WIID2) and the regressions cover the time period between 1960 until 2011. The main findings are that the top income shares can be used as a proxy and that the relative inequality in Norway was not affected much by neither the banking crisis, nor the financial crisis. The top income shares were more affected by the tax reform in 1992 and the implementation of a permanent dividend tax in 2006.

Key words: Top income shares, inverted Pareto-Lorenz coefficient, inequality, Norway, cointegration

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1 Introduction

"The idea of inequality is both very simple and very complex. At one level it is the simplest of all ideas and has moved people with an immediate appeal hardly matched by any other concept. At another level, however, it is an exceedingly complex notion which makes statements on inequality highly problematic, and it has been, therefore, the subject of much research by philosophers, statisticians, political theorists, sociologists and economists."

The statement above is accredited Amartya Sen (1973) and still remains true today. Economic inequality has long been one of the major topics of socio-political debate and conflict. Therefore, one of the central questions in economics and history is the study of the relationship between inequality and development. Economic inequality, both within and between nations, has become a large subject of empirical inquiry over the last decades. Even though inequality is a natural part of well-functioning market economy, too high levels of dispersion of incomes and wealth could be harmful to society through hampered growth rates, crises and eroding social structures between different groups. Thus, we need to study inequality over time in order to understand its driving forces, as well as its long-run impact in society. Simon Kuznets (1953) was among the first in his field to present the idea that income dispersion would affect growth. His theory predicted a rise in income inequality in the beginning "of a change in economic sectors" and then a fall in income inequality toward the end. The phenomenon is referred to as Kuznets' inverted U-curve.

The French economist Thomas Piketty (2003) adopted the same approach as Kuznets (1953) and used compilations of personal tax returns as tabulated distributions, which are currently available in most countries for long periods of time. In recent decades the share of income accruing to upper income groups and inequality has increased in many developed countries. Some studies have shown that much of this development is due to increases in the very top of the distribution, which has resulted in an interest in understanding the details of top incomes.[1]
It is not only the relationship between inequality and development that is of interest. There is a growing concern about how inequality evolves in times of crises, since they seem to go hand in hand.[2] Atkinson and Morelli (2011) show a broad pattern within countries where inequality was high prior to the Second World War, and then lower over the next 35 years of the "Golden Age", and then rose towards the end of the twentieth century. Another finding is that rising inequality may increase the probability of a crisis, however there is a possibility that the causality is the opposite way, indicating that the crisis has distributional effects on inequality (Atkinson and Morelli, 2011).

In order to measure inequality, Leigh (2007; 2009) has investigated the relationship between the top income shares and broader inequality measures, namely the Gini coefficient.[3] His study is based on standardised top income shares for 13 developed countries. The results suggested that top income shares could be used as a substitute for other measures of inequality when other measures of income distribution are unavailable, or of low quality.

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[1] See Jäntti and Sandström (2005), Saez (2005), Waldenström (2009), and Almås et al. (2011)
[2] Trygve Larsen Morset (2013) argues that inequality is closely related to systemic banking crises, with inequality in the front and David M. Kotz (2008) implies that growing income inequality within society is one seed of an eventual systemic crisis.
[3] The Gini coefficient is presented in 4.3

1.1 Aim and research question

This thesis primary objective is to find a cointegration relationship between top income shares and the inverted Pareto-Lorenz coefficient, since Norway was excluded in Leighs' (2007) paper.[4] The cointegration is important, since one way to test whether top income shares are a good proxy for inequality across the distribution is to examine the long-term relationship between income inequality empirically and top income measures. The chosen groups are the top ten percent income share, the top five percent income share, and the top one percent income share in Norway. There are many arguments to why it is motivated to study the high-income earners from a scientific viewpoint. Firstly, the high-income earners are undoubtedly an important group in the society. They constitute a significant tax base and they hold big shares of ownership, which enables them to influence the economic and political agenda. Secondly, this group in society is important in the creation of a more or less equal society and also the possibility to make the society grow by promoting entrepreneurs. Lastly, a third reason relates to the particular availability of historical data on the wealth and income top. However, inequality is not only affected by World Wars, but also by bank crises and financial crises. Therefore, the second objective is to analyse how the top income shares evolve during crises, with focus on the crisis in 1991-1992 and the recent financial crisis in 2008.

The issue raised in this thesis include interplay between a complex set of mechanisms –social, economic and political. Unfortunately, this thesis cannot go into all the complex mechanisms, the aim is to investigate whether there is a long-run relationship between the three top income shares and the inverted Pareto-Lorenz. Afterwards, the development of inequality during times of crises in Norway is described and analysed. In the light of this, the research question for the primary objective is: *Can the top income shares be used as a proxy for inequality?*
The question for the secondary objective is: *How did the banking crisis in 1991-1992 and the financial crisis in 2008 affect top income shares and the Gini coefficient?*

As mentioned, the main focus of this thesis is to analyse whether there is a cointegration between the inequality measurement and the top income shares in Norway. The contribution is that this thesis will try to find a long run relationship between the three chosen groups within the Norwegian income distribution and the inverted Pareto-Lorenz coefficient during 1960-2011 and extend by investigating the development of top income shares and Gini coefficient during the crises.

1.2 Motivation

"For far too long, economists have neglected the distribution of wealth, partly because of Kuznets's optimistic conclusions and partly because of the profession's undue enthusiasm for simplistic mathematical models based on so-called representative agents."

The quote comes from Thomas Piketty (2014) 'Capital in the Twenty-First Century', which emphasizes the wealth concentration and distribution over the past 250 years. Piketty's work is seen as a critical continuation of Simon Kuznets work. Piketty argues that when the rate of capital accumulation grows faster than the economy, inequality rises. He also proposes a global

[4] Cointegration will be presented in section 6.2

tax on wealth in order to address the problem of inequality. He believes that redistribution is one possible way to decrease inequality and since the concern is worldwide, a global tax would redistribute the wealth from the rich to those that are worse off.
Often, the distribution of income is motivated by the idea that inequality is in some sense a 'bad' thing that divides the society. Concern is therefore usually with the question of whether a change in income distribution represents an improvement for the affected parties. Previous research on inequality measures has been motivated by the wish to relate the measure explicitly to value judgements.

Perhaps the choice of objective, Norway, is not the optimal country to perform research concerning inequality because of its good finances, especially with regard to the oil fortunes, which enables them to prevent big economic fluctuations from the international market. Thus, it is still of interest to investigate whether the inequality has been affected by crises.
Hence, one motivation to why we should care about and study inequality in Norway is because we want to know and understand the world around us. A second motivation is normative; inequality is something that people often feel strongly about, that is why two philosophical perspectives are discussed in 2.4. Lastly, for many analysts, concern with inequality may be mainly instrumental. It has been noted that if one tells an economist that inequality has increased the dogmatic answer is 'so what?'. Hence, even if inequality per se is not the worry, economists would want to know what real world consequences may be associated with rising inequality. Even though the consequences are not the main focus, some possible causes will be presented in section 2.3.

Most of the existing research within the field is concerned with the bottom of the distribution.[5] Although, changes in the top income shares may have important implications in their own right, since they usually possess a large economic and political power. Beyond this, understanding the concentration of incomes at the top of the distribution can tell something about the bottom of the distribution. Since, if those at the top have a larger share of the distribution, the ones at the bottom have a smaller one. This is shown by Leigh (2009), which concludes that income concentration in the top of the distribution is highly correlated with relative poverty. Emphasizing that top income shares are not only important for understanding the rich, but also help us understand poverty.

1.3 Delimitations

Norway discovered oil for the first time on the 23rd of December 1969. This has become known as the economic turning point for Norway and also a marker of a new era. Early in the process, the Norwegian government decided to control the oil sector and those who participated in extracting the natural resources. Over the last decades, Norway has grown to become one of the richest countries in the world. The economic turning point will be used as a beginning for the time period, although, in order to detect a long-run trend the time horizon will be set from 1960 to 2011. Since Norway is not a member of OPEC, focus will not be on the two crises in 1973 (OPEC I) and 1979 (OPEC II).[6] Arguably, it would be impossible to cover all the crises, therefore this thesis focus on the banking crisis in 1991-1992 and the recent financial crisis in

[5] For example Grusky et al. (2014) "The Poverty and Inequality Report 2014" or The World Bank (2013) "*Inequality in Focus"*
[6] OPEC stands for Organization of Petroleum Exporting Countries

2008. Crises are often discussed at an aggregate level, although the prime concern will be how crises affect specific groups within Norway. The time delimitation is set in order to hopefully be able to discern a pattern over time.
Due to the lack of an axiomatic theory regarding inequalities, the thesis will use an inductive approach, by adopting previous research as a framework when conducting the analysis, but also a deductive approach when analysing the impact of crises on inequality. That is why the thesis starts off with a broad notion of inequality and then narrow it down to the prime object, being income inequality and inequality during crises.

Recent research in the top income literature proposes that the rich are not alike but on the contrary a rather heterogeneous group in society (Waldenström, 2009). Therefore, in order to see whether different groups interplay different with the relative inequality, the top decile has been divided into three groups (one percent, five percent and ten percent).[7] One implication with the chosen groups that needs to be noted is that the three chosen groups are interrelated in themselves. Top one percent is found in both top five and top ten percent and top five is found in top ten percent income shares. However, this is conscious choice since the VEC model allows me to see which of the three groups have the largest effect on inequality or vice versa.[8]

Though, there is no consensus in the literature regarding the outcomes of inequality, some argue that inequality promotes investment and others that too much inequality is destructive and a reason that hampers a countries economic growth. Due to the lack of available data, the regressions conducted could not include variables such as capital, investments, globalization, interest rates or change in government. The thesis is therefore solely focused on the evolvement of top income shares, the inverted Pareto-Lorenz and the Gini coeffient when analyzing crises. Furthermore, the thesis does not wish to analyse the mobility of individuals, or the impact inequality has on growth (GDP) and poverty reduction. The main ambition is to contribute to the literature concerning if top income shares are a robust inequality proxy and how top income shares developed in Norway. Initially, the aim was to include the Gini coefficient in the regressions, but due to data availability, only the inverted Pareto-Lorenz will be included. Another preferable variable to include would have been the capital income. Albeit, according to Almås et al. (2010) the data on capital income are of low quality, primarily because most individuals have their wealth invested in the house where they live.

1.4 Outline of the thesis

An introduction to the subject, this papers aim, motivation and delimitations has been presented in the prelusive part of the thesis. Chapter two will review earlier related studies on economic inequality and income inequality, together with some of the driving factors of inequality in general using secondary sources, in order to examine matters related to income inequality in Norway. Subsequently, focus will specifically be on income inequality and the present situation in the OECD countries and Norway.[9] Chapter three will shed light over inequalities during crisis, with main focus on the banking crisis and the financial crisis. In the following section, before describing the chosen data, three inequality measurements will be defined in chapter four. Afterwards, chapter five contains a description of the data used in this paper, derived from the

[7] A decile divides the sorted data into ten equal parts, meaning that each decile represents 1/10 of the population.
[8] Vector error correction model presented in 6.3
[9] OECD stands for Organisation for Economic Co-operation and Development

Wider Income Inequality Database v.2 (WIID2). The methodology will be presented in chapter six, where the various tests and procedures are thoroughly described. Chapter seven will present the empirical results. In chapter eight the main findings and their implications are discussed, together with the analysis regarding the evolvement of top income shares and Gini during the crises. The thesis ends with the overall conclusions in chapter nine.

2 Previous Research and Literature Review

This chapter begins with an overview regarding previous research within the field of inequality. Thereafter, the distinction between economic inequality and income inequality is discussed prior to some possible factors that affect inequality. Subsequently, two philosophical perspectives regarding how inequality can be understood are presented before the discussion of why equality is an important fundament in society. The chapter concludes with a discussion concerning the general inequality trends in the OECD countries and the trend specifically in Norway.

2.1 Previous research

A substantial body of research on economic inequality has been accumulated over the past 50-60 years, mainly building on pioneering empirical studies such as those of Kuznets (1953) and Mincer (1958). Top incomes portray a small share of the total population, but are a significant share of total income and total taxes paid. Recent literature from Piketty (2003) and Atkinson, Piketty and Saez (2011) provides evidence of a dramatic drop in top income shares in the first part of the twentieth century. The drop was mainly due to unionization and rising wages, progressive income tax rates, but also due to nationalizations and expropriations. Lastly, they provide evidence of a substantial increase over the last thirty years, mainly due to an increase in the exceptional growth in top wage incomes.

Over the last decades, economic inequality in general and income inequality in particular have been showing increasing trends in developed economies. Jäntti and Sandström (2005) provide evidence of the within-country inequality trends using a compilation of inequality estimates from as many countries in the world that is currently available. They use a new set of data, the updated World Income Inequality Database (WIID2) in order to find robust evidence on inequality trends. Their results suggest that inequality has increased in most countries and more specifically, that the increase in inequality seems to have occurred mainly though a disproportionate increase in the income share of the richest fifth. Atkinson et al. (2009) base their study on aggregated economic growth per capita, the Gini index and top incomes. Their results show that most countries experienced a sharp decline in top income shares in the first half of the twentieth century, mainly around key episodes like the World Wars or the Great Depression. They found that the main reason for the fall in the top percentile was primarily caused by a reduction in top wealth concentration. The data used to measure the top percentile income in their regression consisted mainly of capital income as opposed to labor income (Atkinson et al., 2009).

Almås et al. (2010) study the implications of responsibility-sensitive theories of justice for the evaluation of the income distribution in Norway from 1986 to 2005. They believe that some inequalities are fair and introduce the unfairness Lorenz curve and the unfairness Gini index, which are generalizations of the standard versions of the Lorenz curve and the Gini. They find that both the pre-tax and the post-tax income distributions have become less fair in Norway, even though the Gini coefficient decreased during this time period. Atkinson et al. (2009) also introduced a new way of measuring inequality, the inverted Pareto-Lorenz curve obtained by examining the shares within shares. They showed that Norway had a similar development as

Sweden and the UK over the twentieth century, with falling top income concentration and then rising toward the end of the century. Aaberge and Atkinson (2008) present a study concerning top income shares in Norway between 1875 and 2006. They divide the population into six groups: top 10 percent, 5 percent, 1 percent, 0.5 percent, 0.1 percent and 0.05 percent. The data used is before tax income micro-data. Their results show the same as Atkinson's (2009) findings, that there has been a decline in top income shares during the war years and a change in direction due to the liberalization of the market around the 1980s, with the first visible difference in 1992.

Moreover, there has been a revival of interest in the study of the distribution of top incomes using income tax data. Piketty (2003) has constructed top income share time series over the long-term for more than twenty countries, using the similar methods as the pioneering study by Simon Kuznets (1953). His main finding from the study covering France between 1901-1998 was that the first decline in income inequality that took place during the first part of the twentieth century was mostly accidental. He argues that income inequality in most of the world has been stable in the long run. Though, Piketty (2003) denotes that the second decline in income inequality during the post-war period was a capital income phenomenon. Aaberge and Atkinson (2010) explore the long-run changes at the top of the income distribution in Norway by using the same method as those used by Piketty (2003). They conclude that the top income shares fell steadily during the period after the Second World War, due to central planning of the economy, very progressive taxation, and gradual expansion of the welfare state. In the post-War period around 1948 the Pareto-Lorenz coefficient was around 2.25, but rose to close 4 at the end of 1970s. The turning point for the Pareto-Lorenz occurred in the 1980s and the turning point for top incomes shares came at the start of the 1990s.

Waldenström (2009) has analysed the long-run determinants of inequality, and focused mainly in what we can learn from top income data. He used available panel dataset with 16 countries over the whole twentieth century in order to study the role of political, technological and economic factors when explaining the evolvement of income inequality. Waldenström's study, like Aaberge and Atkinson's (2010) categorizes the rich into groups –the rich (one percent), the upper middle class (ten percent) and the rest of the population (ninety percent). His results indicate that periods of high-income growth disproportionately increase the top percentile income shares at the expense of the rest of the top decile. His research also covers the outbreak of banking crises, indicating that crises lead to reduced income shares of the rich, although when analysing financial development, it seems to benefit the rich. Lastly, Waldenström (2009) views the effects of progressive taxing and his results show that they reduce top income shares.

There is still controversy on the effects that income inequality has in the long-term. Castells-Quintana and Royuela (2014) discuss both some positive and negative aspects concerning the relationship between inequality and growth. One negative aspects of inequality is the risk for social-political instability, which reduces investment and growth. Another is the political economy approach, where high inequality leads to higher redistributive pressure, which might lead to economic disincentives. One positive aspect of inequality is that it leads to higher aggregated savings, hence higher level of investment and growth.

Summary

Most countries, including Norway, experienced a decline in top income shares during the first half of the twentieth century. Atkinson et al. (2009) argue that it was because of a reduction of wealth concentration in the top, while Piketty (2003) that it was due to changes in capital income. Aaberge and Atkinson (2010) find that the decline in Norway was due to central planning, progressive taxation and the gradual expansion of the welfare state. Further, this thesis emanates from research conducted by Aaberge and Atkinson (2010), where the top income shares for the

chosen groups are gathered, in combination with the research from Leigh (2007) where the relationship between top incomes and the Gini coefficient is investigated. Though, instead of analysing the Gini coefficient and top income shares in the long-term, this thesis investigates the inverted Pareto-Lorenz coefficient and top income shares in the long-term.

2.2 Economic Inequality and Income Inequality

Economic inequality has many dimensions. A variety of variables can be used to evaluate the distribution of living standards in a society. Monetary indicators can be used, such as expenditure, income, and wealth or non-monetary indicators like happiness and life satisfaction. As mentioned earlier, this paper is strictly concerned with income. Thus, it is of importance to define the discrepancy between different inequalities and their role in society in a broader sense since income is far from the only determinant of well-being. The distinction between economic inequality and income inequality is essential. Sen (1997) argue that the important note is that the valuation of income is entirely as a means to other ends and also that it is one means among others. Economic inequality is defined as the gap between rich and poor, whilst income inequality measures the difference. Income is a crucial and important mean, but its importance lies in the fact that it helps individuals accomplish things that they value doing and to achieve states of being that they wish to attain. One example is when giving a share of income to a person with more needs, say due to a reduced ability, can be seen as weighing against the broader dogma of economic equality, since the greater need for economic resources due to the disability must be taken into consideration when judging the requirements of economic equality (Sen, 1997).

It is not only the distinction between economic and income inequality that is of relevance. Income is also correlated with wealth, this makes overall wealth inevitable to exclude in the discussion regarding income inequality. Wealth is more unequally distributed than earnings or income, which implies that even though the distribution of income is relatively equal, the economic inequality in total is de facto much higher (Davies, 2009). Therefore, the value of incomes cannot stand separated from the deeper concerns as economic inequality, and a society that respects inhabitants' well-being and freedom must take note of these concerns in making interpersonal comparisons as well as social evaluation (Sen, 1997; 1999).

Within-country inequality and in particular within-country trends can be hard to come by. Income inequality has increased over the past decades in many OECD countries. According to research conducted by Hoeller et al. (2012) growth has not lifted incomes in all the society to the same extent. In some countries, top income shares have taken a large share of the overall income gains, while the income for most of the population has only increased marginally. Some main findings in the paper are that countries differ greatly with respect to the level of labor income inequality among individuals of working age. The labor income inequality is mainly shaped by differences in hours worked, wage rates and inactivity rates. Hoeller et al. (2012) also discuss some positive aspects that inequality has on growth. They find that through a higher saving rate of the rich (the investment rate is positively related to saving rate), unequal countries will experience a faster growth, which is the same results as Castells-Quintana and Royuela presented in 2014. Again, wealth is inevitably involved in the discussion about income inequality, since concentration spurs the creation of new activities and creating work incentives that generates a more equal society. Some of the aspects that give rise to a negative development between inequality and growth are endogenous fiscal policy, socio-political instability and credit market imperfections (Hoeller et al. 2012).

2.3 Driving factors of economic and income inequality

As mentioned in the delimitation, it is not the papers main objective to analyse the various factors driving inequality. Though, it is highly important to present previous findings in order to provide a comprehensive description to the reader and also be able to contrast the empirical findings. In theory, various kinds of shocks can change a nation's inequality. Increases in household income inequality have mainly been driven by changes in the distribution of wages and salaries, accounting for 75 percent of household incomes of working age individuals. In the OECD, wages of the ten percent best-paid workers have increased relative to those of the bottom ten percent least-paid-workers. According to Atkinson (2008) this was due both to growing earning shares at the top and declining shares at the bottom, although top earners experienced a particularly rapid rise in their incomes (OECD, 2011a).

Another possible driving factor of economic inequality could be the type of jobs people hold and their work arrangements. For example women's ratio in the workforce or changes in working-time arrangements. More hours were lost among low-wage than among high-wage earners, creating a wider gap (OECD, 2011a). A third factor that can have a significant role is self-employment, since it is more unequally distributed across countries than wages. Self-employment is often disproportionally concentrated in the lower income groups in most OECD countries. Though, the main focus regarding the driving factors of inequality is the distribution of incomes from capital, but also investment and savings, property and private transfers that has become more unequal in the OECD countries (ibid.).

Roine et al. (2009) studies the long run determinants of income inequality using a panel consisting of 16 countries over the entire twentieth century. They focus on three groups of income earners: the rich (one percent), the upper middle class (ten percent), and the rest of the population (ninety percent). Their results show that periods of high economic growth in a country disproportionately increase the top percentile income share at the expense of the rest of the top decile. A second result is that financial development benefits top income earners. Thus, the outbreak of banking crises often results in reduced income shares of the rich. They also find that trade openness has no clear distributional effect. Government spending affects the top ten percent negative and the nine lowest deciles positive, however, it does not seem to affect the rich. Lastly, they find that tax progressivity reduces top income shares and when they account for real dynamics they find the impact important over time.

Rogowski (2008a) also lists some possible causes in his paper, with at least four non-mutually exclusive explanations leading the field. 1) Skill-based technology change: Machines and computers that substitute low-skill labor and increase the demand for high-skilled workers. 2) Globalization: Increased trade with low-skill regions is driving down the low-skill wages, hence increasing high-skill wages. 3) Educational failure: The schools and universities in developed countries are supplying fewer high-skilled graduates, thus losing the "race with technology" that is discussed further in Goldin and Katz (2008).[10] 4) Governmental policy: Inequality increase when "neo-liberal" policies gain power and when governments actively try to redistribute or retrain.

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[10] Claudia Goldin and Lawrence Katz argue that the pattern of changing income inequalities in America is the outcome of a continuous "race between education and technology". When education leads, inequality supposedly falls, and vice versa.

Leigh (2009) lists a few principal drivers of changes in top income shares. Amongst some possible explanations to why inequality decreased in many Anglo-Saxon countries during the 1980s and 1990s, was because of the top tax rates that were implemented on the top labor incomes, but also the social norms that had a great effect on executive compensation. Another aspect, which several studies have investigated, is the relationship between marginal tax rates and top income shares, for example Roine and Waldenström (2008) in Sweden and Saez (2004) in the United States. Although the methodology differed, three general conclusions can be drawn from the conducted studies. 1) Taxes seem to affect top incomes in two ways. Firstly, through an immediate work-preventative effect and secondly, from a lagged effect via capital accumulation. 2) Tax rates seem to be a central determinant of top income shares in many developed countries. 3) The higher up in the distribution one looks, the more responsive top income groups seem to be to tax rates (Leigh, 2009).

In general, these are a number of factors driving inequality and are therefore interesting when studying the development of top income shares. Understanding the breadth of inequality at the top and the relative importance of the various driving forces leading to increasing top shares is important in the design of public policy. In some countries, concern about the rise in top shares has led to proposals for higher top income tax rates, while other countries are considering limits on remuneration and bonuses (Atkinson et al., 2009).

2.4 Two philosophical perspectives

Prior to the discussion of why equality is desirable, we need to acknowledge some philosophical aspects in order to take a step closer to the foundations of inequality. There are three fundamental arguments put forth for the desirability of economic equality. The first reason is grounded in justice, and springs from John Rawls work from 1971 that challenged utilitarianism, the predominant way of justice of traditional welfare economies (Sen, 2000).[11] Rawls argues that the features of individuals that determine the economic outcomes they will enjoy are arbitrary from the moral viewpoint regarding talents, environments and birth-families. As a consequence, economic inequalities cannot be deserved. The second argument is that inequality has deleterious effects on human welfare. The third reason is that equality is the fairest way to share scarcity. Assuming that there is insufficient wealth for everyone in order to develop a reasonable plan of life, equality is the fairest way to ration (Roemer, 2009).

Naturally, each of these reasons can be challenged. Nozick standpoint is anti-Rawlsian, and claims that even though assets are not chosen, individuals may still be rightly held responsible for what he or she does with them. Hence, as long as requirements of non-discrimination and equality of opportunity are met, unequal outcomes are morally acceptable. Furthermore, even if equality is deemed desirable, implementing it might lead to an impoverishment for all. Therefore, redistribution should be limited, because a too extreme stance might lead to a setback for the whole of society. For example if innovators and individuals that are very productive cease to be as compelled to innovate. Rawls in particular recognize this scenario and does not require total equality, but would rather maximize the share received by the group that is the worst off (ibid.). Waldenström (2010) also discuss two political and philosophical perspectives, but in relation to the financial crises in 2008. The first being Rawls' theory that concerns inequalities in outcomes, as mentioned above, and the second focuses on the inequality of opportunities. Though, it is not

[11] The pioneers within the field of utilitarianism are John Stuart Mill and Jeremy Bentham.

easy to evaluate inequalities in outcomes and opportunities. This is so because differences in outcomes is often measured as households or individuals' disposable income and the opportunity inequalities are often measured as the degree of mobility between different classes in society (Waldenström, 2010).

In conclusion, Rawls view does not focus on the differences, but rather on how big the gap is between different groups in the society, hence discussing economic inequality. His concept of justice as fairness is based on the requirements of justice on the need for fairness. The other standpoint, Nozick, is more anti-egalitarian claiming that self-ownership should be used in order to nullify the morality of unequal distribution. This part has provided the reader other, more nuanced perspective when analysing inequality, instead of just calculating income and GDP per capita.

2.5 Why equality is important

Rising inequality concern all classes in the society. Rogowski (2008b) discuss the possibility of "vicious" and "virtuous" circles when inequality increases with regard to four effects; human capital, economic growth, democracy, and redistribution. He also states some possible outcomes of a decline in inequality. According to theory, human capital will accumulate more rapidly and physical capital more slowly. The political status and participation will become more equal, leading to a higher demand for redistribution. Another possible outcome is that economic growth will accelerate in sectors and time-periods that depends mostly on human capital and decelerates in sectors where physical capital is overrepresented.
Decreasing inequality means a decrease in the relative wage, which stimulates the substitution of other factors for labor. Whilst, increasing inequality implies that labor is substituted for other factors, such as restricted political participation and rising incentives for technical innovations that use land and capital more efficiently (Rogowski, 2008a).

In theory, the Meltzer-Richard model (Meltzer and Richard, 1981) predicts that economically more equal democracies will redistribute less. In short, the more equal the society is, the closer is the income of the median voter to that of the average voter. Since it is believed that it is the median voter that determines the outcome of an election in a democracy it is unlikely that the voter demands redistribution of income. But in reality, virtually every over-time examination has shown exactly the contrary, namely that the more unequal the democracy the less it redistributes (Rogowski, 2008b). Although, the Meltzer-Richard is displaced by what Peter Lindert calls the "Robin Hood paradox", referring to that it is the most equal societies that redistribute the most (Lindert, 2000). Lindert's explanation essentially says that the poor lack the resources to mobilize politically. Therefore, as societies become more equal, they will redistribute more and will also increase their support for parties that support such redistribution, which is usually "the Left".

2.6 Trends in income inequality

The following two sections will provide the reader with an overview concerning present trends in income inequality in the OECD countries and subsequently specifically in Norway. This is discussed in order to get a broader understanding of the current trend regarding economic inequality and income inequality. One general trend is described by Leigh (2009), he analysed the top ten percent share and the top one percent share for Anglo-Saxon and non-Anglo-Saxon countries. His results show that the top incomes peaked at some point between the start of

World War I and the end of World War II. For most countries, the income share of the top one percent bottomed out from the 1970s to the 1990s.

2.6.1 The OECD countries

Overall, real disposable household incomes have increased in all OECD countries during the last decades. Nations concerns about increasing income inequality, but also wealth have fuelled social and political debates. In a vast majority of OECD countries, household incomes of the top 10 percent grew faster than those of the poorest ten percent, resulting in an increased income inequality. The differences in the pace of income growth across household groups were particularly obvious in some of the Nordic countries and some of the English-speaking countries. The average income of the richest ten percent of the population is about nine times that of the poorest ten percent, albeit the ration is much lower in the Nordic countries. The Gini coefficient stood at 0.28 in the mid-1980s on average in the OECD countries and by the late 2000s, it had increased to 0.31 (OECD, 2011a). Gottschalk and Smeeding (2000) performed cross-national comparisons between the OECD countries and found that the income inequality had increased in 12 of the 17 countries examined from 1979 to 1995. They found a similar pattern as Aaberge and Atkinson (2010) did for Norway, that inequality decreased throughout the 1970s and then increased in the mid-1980s through the mid-1990s. Although, Gottschalk and Smeeding emphasize that the rises we are seeing today are a compensation of the gains made during the 1960s and 1970s.

Recent findings also show that the economic inequality, meaning the gap between rich and poor in the OECD countries have widened over the three past decades, reaching an all-time high in 2008. The global economic crisis has squeezed incomes from capital and work in most countries. Still, there are large differences in level of income inequality across the OECD countries, with a high inequality in Mexico compared to a relatively low in the Nordic countries. Not only is this shown by the Gini coefficient, but also from an alternative indicator of income inequality, through looking at the gap between the average incomes of the richest and the poorest ten percent (OECD, 2013).

2.6.2 Norway

In comparison to other OECD countries Norway's wage distribution developed differently, despite the fact that the country faced a similar supply and demand condition. Workers at the bottom gained income shares relative to the middle during the years 1987-1991, when low-wage workers in other countries were losing ground. Kahn (1998) argues that this was due to the bargaining that took place at a national level during the 1960s and 1970s. However, in 1981 there was a change to a conservative government for the first time in 50 years. In 1982 the conservative government decided not to take part in the wage bargaining and the Norwegian Federation of Trade Unions (Landsorganisasjonen (LO) i Norge) agreed to more decentralized negotiations. By increasing the opportunities for differing wage outcomes across firms, decentralisation of bargaining is hypothesised to raise wage inequalities (Kahn, 1998). Although, there was a return to centralized wage bargaining in 1988, which lead to a period that Kahn refers to as a period of 'recentralisation' between 1988 and 1991.

Atkinson (2008) argues that the period up to 1980 shows minor changes at the top, although the bottom of the distribution, relative to the mean, indicate a rising trend that can be due to the

changes in the composition of the population covered. Due to the lack of annual data, it is not possible to reveal the impact of decentralization of bargaining in the 1980s. Although, from 1987-1991, the OECD data show a ten percent rise in the bottom decile, which is in line with Kahn's findings that recentralisation reduced dispersion. Overall, Atkinson (2008) found that the changes in the top decile were not large enough to register, even if the data for the 1990s show a small rise in the upper percentiles. A tax reform was introduced in 1992, which made income from self-employment part of the definition of labor earnings. The change affected the upper tail of the labor earnings distribution and increased the variance of labor earnings. The tax reform led to a sharp increase in dividend and capital gains among the richest households (Aaberge and Atkinson, 2010; Almås et al., 2010).

Aaberge and Atkinson (2010) denote that the turning-point was the oil revenues that may have been favourable to the public finances, but they did not spark off an increase in the top income shares. Rather, the increases in top income shares that occurred in the early 1990s were mainly related to a major reform of the financial markets from the 1980s, which included the abolishment of credit rationing. Though, the implementation of the tax reform in 1992 did not only end the banking crisis, but it changed the business cycle from a period of recession (Aaberge and Atkinson, 2010). These were the general trends in the OECD countries and respectively Norway, the next chapter will discuss both some theory and empirical findings concerning inequality in times of crises.

3 Inequality During Crises

Another concern with rising top income shares, in addition to equity and redistribution, is the potential impact on macro financial fragility. The interest in this section lies in what findings in previous research say about the relationship between income and inequality during economic crises, such as banking crises and financial crises. Some, but not conclusive evidence, show that financial crises often are followed by rising inequality in the medium-run. Others mean that too high levels of inequality lead to financial crises.[12] Bordo and Meissner denote that there is no general relationship between rising inequality and crises or between increased top incomes and credit booms, while others say that top income shares decrease following a systemic banking crisis in the short-run.[13] Though, they find no evidence of credit booms being set off by a rise in top income shares.

Milanovic (2009) argues that the deeper cause of the recent financial crisis was income inequality. He argues that increasing income inequality led to affluence in investible funds searching for higher returns, which only could be accomplished through very risky investments. Atkinson and Morelli (2011) discuss both ways of causality; if inequality leads to an economic crisis and how economic crisis affects inequalities. They conclude that the period before the financial crises in 2007-2008 did see increasing inequality in a number of countries, and specifically an increased share of total income accruing to the very top of the distribution. Roine, Vlachos and Waldenström (2009) recently concluded that a banking crisis would reduce the income share of the top one percent. Although, Atkinson and Morelli (2011) say that a change today may work in the opposite direction. The second part of the analysis will be based on these arguments (sections 8.1.1 and 8.1.2), where main focus will be at how the top income shares evolve, but also how the Gini coefficient uncoils during this period.

3.1 Crises in Norway

Norway is a small country with an open, capitalistic economy where import and export make up a large portion of GDP. The country is characterized by strong collaborative aspects, which is demonstrated by the fact that 52 percent of the Norwegian workforce is organized in trade-unions (Knutsen, 2012; Langeland, 2012). The dual income tax in Norway is characterized by a proportional tax on capital income and a progressive tax on earned income (Alstadsæter and Fjærli, 2009). Given the smallness and openness of Norway's economy, most economists are astonished by the relatively small impact the international problems have. Norway has had nine major financial crises from the time of the country's independence in 1814 until today (Grytten and Hunnes, 2010). Since there are many different forms of crises, this section will mainly focus on two. Starting by presenting the banking crisis and afterwards continue with the recent financial crisis.

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[12] See Rajan (2010) and Kumhof and Ranciére (2011)
[13] Credit booms are said to increase the possibility of a banking crisis.

3.1.1 The banking crisis

Norway, like all the Nordic countries, experienced a financial turmoil over the period 1987 to 1994. After a quantitative financial deregulation removing caps on lending rates, Norwegian banks began engaging in risky credit operations, which resulted in a bank-lending boom. In 1985 the government lost the majority in the election, the centralized wage settlement resulted in wage increases and shorter working hours. In the late 1985 oil price fell sharply, and in 1988 Norway had the first bank failure since the 1930s, which caused small banks to fail, credit froze and there was a shortage of capital (Vale, 2004; Grytten and Hunnes, 2010). The liberalization process led to a sharp increase in lending from Norwegian banks and had an impact on both the demand-side and supply-side of the economy (Knutsen, 2012).

The crisis reached its peak in 1991-1992 when Norway suffered from a systemic crisis. Thus the government intervened and proposed to the Storting (the Norwegian parliament) to organize a Government Bank Insurance Fund (GBIF). In 1992, Norway de-peged its currency from the European currency unit (ECU) and the krone started to float, which made it possible to make reductions in Norwegian interest rates. By the end of 1993, Norwegian banks started to regain credibility and in 1994, the largest bank raised equity in a joint operation with the GBIF selling out part of its shares to the market (Vale, 2004).

Atkinson and Morelli (2011) and Steigum (2004) show that the share of the top one percent was almost flat from the 1980s until the crisis, indicating that the de-regulation of the banking industry did not seem to result in an immediate rise in the top income shares, nor did the crisis lead to a clear fall from 1987 and onwards. The overall inequality, measured by the Gini coefficient rose by 2,5 percentage point between 1991 and 1996, while the rise in the top ten percent started in 1996. Atkinson and Morelli (2011) denote that the increase in inequality could be caused by a lagged response to the deregulation of the financial system and not just the banking crisis. According to Steigum (2004) the two main factors that led to the banking crisis after the deregulation of capital account and credit markets, were the fixed exchange rate and the pro-cyclical monetary policy.

3.1.2 The financial crisis

No country integrated into the global economy was left unaffected by the previous financial crises, and Norway is no exception. However, Norway managed relatively well compared to other countries. From 1992 until 2008 the Norwegian credit almost quadrupled, resulting in the creation of asset bubbles. Assets were in a bigger extent financed by loans with generous interest rates. Annual growth rates of house prices were almost 12.5 percent between 1993 and 2007, and inflation were at the same time less than two percent. In comparison, the house prices in Norway increased twice as much as the US during the same time period. Norway experienced the fastest and second largest stock market crash in 2008 (the largest crash occurred in 1919-1921). House prices fell dramatically, but due to rapid cancellations of new buildings and low interest rates, the Norwegian crash stopped in January 2009 (Grytten and Hunnes, 2010).

Typically, a financial crisis occurs after a boom in a country's financial markets, followed by rising stock market and land prices, which disproportionally benefits the rich in a society. Though, after the crash, it is usually the rich who have lost most. This refers to what (Atkinson and Morelli, 2011) call a "classic Λ-shaped pattern" with the crisis preceded by rising inequality at first and then followed by falling inequality.

The period prior to the financial crisis in 2007-2008 did see rising income inequality in various countries, where there was an increased share of total income accruing especially to the very top. According to Knutsen (2012) the triggering cause of the financial crisis in Norway was the aforementioned sharp drop in the oil prices during 1985-1986, in combination with the stock market crash on Wall Street.

Another important occurrence that affected the top income earners was the Norwegian shareholder income tax that was announced in 2005. It meant an increase of the marginal tax rates on individual dividend income from zero to 28 percent (Alstadsæter and Fjærli, 2009).
After the crisis, the impact depends on whether it is followed by a deep recession or not (Atkinson and Morelli, 2011). Overall, a booming stock market contributes both to the rise of top incomes (mostly though capital gains) and to the rise of financial fragility. Although, Piketty and Saez (2012) imply that this does not mean that there is a causal relationship between rising inequality and financial fragility.

4 Measuring Income Inequality

This section presents the Lorenz curve, the inverted Pareto-Lorenz coefficient and the Gini coefficient. The inverted Pareto-Lorenz will be used when testing for the cointegration relationship and the Gini coefficient will be used combined with the top income shares when analysing the times of crises. The choice of using three different indices was made since inequality trends within countries depend on the index chosen. Measures of inequality can according to Sen and Foster (1973) be divided into two categories: those that measure in terms of a normative notion of social welfare and the loss incurred from unequal distribution and those that measures in some objective sense the positive measures that make no explicit use of any concept of social welfare. I will mainly focus on the measurements that are applicable in this context and not inequality measures in the sense of poverty reduction.

4.1 The Lorenz curve

In the present context, inequality is defined as the extent of disparity in the distribution of income. Therefore, the interest lies in the disparity of a percentage of the population and the percentage of income that population receives, as can be plotted by the Lorenz curve. The Lorenz curve was developed by Max O. Lorenz in 1905 and is defined as the share of total income accruing to those below percentile p, as p goes from 0 (indicating the bottom of the distribution) to 100 (the top of the distribution). This measurement requires that there is information available about the incomes of a number of individuals. The first step is to arrange the individuals in ascending order according to their incomes. Afterwards, moving from the poorest to the richest individual, the Lorenz curve plots the proportion of individuals against the equivalent proportion of total income obtained by those people. The Lorenz curve shows the relationship between the proportion of people with income less than or equal to a specified amount, and the proportion of total income obtained by those individuals. When incomes are unequal the proportion of people is always below the proportion of total income (Creedy, 1996). In other words, the Lorenz curve is the graph of cumulative income shares plotted against cumulative population shares. The curvature of the Lorenz curve outlines the inequality. Hypothetically, if everybody had the same income it would represent the perfect equality case and the curve would lie along a 45 degree ray from the origin. Another scenario would be if an income were held by just one person, the curve would the lie along the horizontal axis and represent total inequality (Jenkins and van Kerm, 2009).

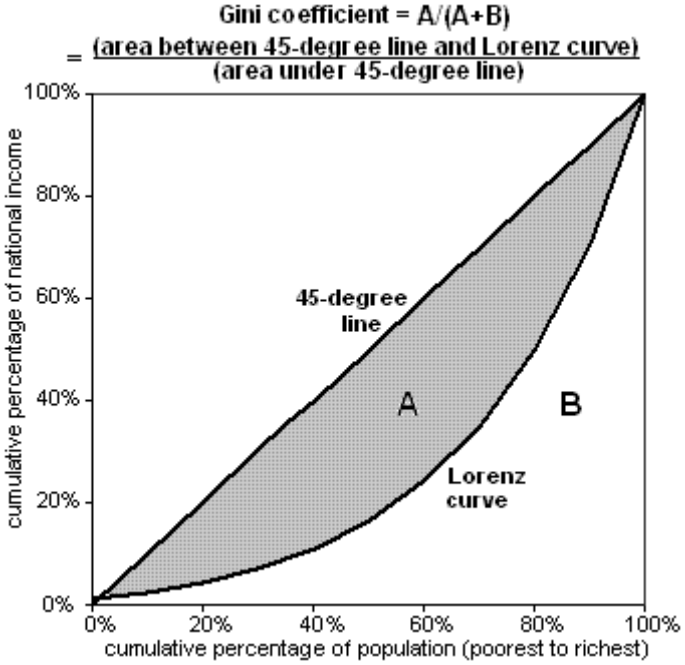

Figure 4.1:The Lorenz curve and the Gini coefficient

Source: (CIA, 2007)

Although, Creedy (1996) points out that the Lorenz curve allows an unambiguous inequality comparison of income distributions, since it only uses the principle of transfers when the curve for one distribution lies entirely outside that of another distribution. This disadvantage will not affect the use of the measurement, since I will only use one objective to analyse. Furthermore, the Lorenz curve is a good measure since it is scale invariant, indicating that the measures derived from the Lorenz curve inherit this property.

4.2 The inverted Pareto-Lorenz coefficient

Vilfredo Pareto (1895) originally used the distribution to describe the allocation of wealth among individuals, but it is also used to describe the allocation of income. Within economics, Pareto efficiency is a state of allocation of resources where it is impossible to make any individual better off, without making at least on individual worse off. Pareto suggested the negative of the slope $-\alpha$ as an indicator of inequality in the underlying population, implying that small values of α relates to a high inequality. Atkinson et al. (2009) use the inverted Pareto-Lorenz coefficient, β instead of Pareto's α. They define the coefficient as:

$$\beta = \alpha/(\alpha-1). \qquad (4.1)$$

Where α is called the Pareto parameter. The β is defined as the ratio $y^*(y)/y$ between the average income $y^*(y)$ of individuals with income above y and the threshold y.[14] The higher β coefficient, the larger is the upper tail of the distribution and thus greater inequality. This also means that the

[14] The "α" coefficient is the standard Pareto-Lorenz coefficient used in power-law distribution formulas (Atkinson et al., 2009)

larger the coefficient, the higher the concentration of income. The Pareto-Lorenz coefficients are not affected by the totals and allow one to see the changing shape of the top of the distribution (Aaberge and Atkinson, 2010; Atkinson et al., 2009). The regressions will only use the inverted Pareto-Lorenz coefficient, since it is more intuitive when studying the top of the distributions. The advantage when using the inverted Pareto-Lorenz is that a higher coefficient means larger top income shares and higher income inequality. One drawback with the measurement is that it only captures dispersion in the top of the distribution and do not relate top incomes to average (Atkinson et al., 2009). That is why the Gini coefficient is used when analysing the relative inequality in times of crises.

4.3 The Gini coefficient

Corrado Gini developed the Gini coefficient in 1912 as a summary measure of income inequality in society. Today, it is one the most commonly used inequality measurement, and it is defined as the ratio of the area between the Lorenz curve and the line of equality over the summed area under the line of equality (as shown by figure 4.1). It ranges from zero, indicating perfect equality, to one meaning perfect inequality. The measure is more sensitive to transfers at the center of the distribution than at the tails (Atkinson et al 2010; Alvaredo, 2010). The Gini coefficient measures the relative inequality, as it is the ratio of a measure of dispersion, which is the mean difference to the average value (Gastwirth, 1972). Some virtues of the measurement are that it is scale independent meaning that it does not consider the size of the economy and it is also population independent. Another feature is that it does not matter who the low-income and high-income earners are. Though, there are also some limitations since the Gini coefficient measures relative, and not absolute income inequality the change in inequality can be due to structural changes in society (Cowell, 1995).

From a philosophical point of view, the Gini coefficient can be interpreted as a transformation of an index of "envy" that is evaluated through contrasting the income of an individual and that of all other individuals richer than her or him (Atkinson and Bourguignon, 2000). Since the Gini coefficient reflects the whole distribution and is mainly sensitive to the fluctuations accruing in the top and bottom in the distribution, the ambition is that it will be used to graphically compare top income shares with the measure between 1990 and 2011. This is done in order to see the impact the crises had on relative inequality during this time period. Overall, inequality measurement is an attempt to give meaning to comparisons of income distributions. In this chapter the reader was provided with an overview of the measures that are being used in the analysis. The forthcoming chapter will present the data used and the limitations with secondary data use.

5 Data

This study employs annual data covering the period from 1960 to 2011. The use of quarterly data could have allowed a more detailed analysis, especially during the periods of crises. However, such statistics are not available for some of the chosen variables. The variables used are: 1) Top ten percent income share (top10) 2) Top five percent income share (top5) 3) Top one percent income share (top1) 4) Inverted Pareto-Lorenz coefficient (IPL) 5) Gini coefficient (gini). The top income shares are measured as percentages, the Gini ranges from zero to one and the inverted Pareto-Lorenz "typically vary between 1.5 and 3" (Atkinson et al., 2009:12) and ranges from 1-10. Values around 1.5-1.8 indicate a low inequality, while values above 2.5 indicate very high inequality. The income shares are calculated as follows:

*Share of X% =Proportion of earned income*Share of top X% of earners*Alignment coefficient for earnings*

The data originates from the revised World Income Inequality Database v.2 (WIID2), a secondary database published by United Nations University (UNU) – World Institute for Development Economics Research that contains information on inequality in 115 countries of the world. The database was updated in 2005, some new features in the dataset are that low-quality estimates were deleted and replaced with high-quality estimates. The new data also contain the Gini coefficient and income group share data with decile group shares, along with the income shares of the poorest 5 percent and richest 95 percent of the population. Concerning the demands on the underlying data, a list of preferable features are pointed out, such as coverage issues, questionnaires and data collection methodology was mainly paid attention to. Regarding covering issues, national coverage is desirable and attention was paid to the exclusion of some special groups such as households above a certain income threshold or households only living on charity (Jäntti and Sandström, 2005).

More specific, the data used for the Norwegian data set in the WIID2 originates from two income surveys conducted by Statistics Norway in 1993 and in 2000. The sample size is between 6000 and 10 000 households in 1993 and 14 000 households in 2000. The data are mainly based on tax returns, but also includes many non-taxable income items. The income definition industrialized countries use is disposable income. That is the sum of wage income including both cash and selected non-cash payments, but also self-employment income net of business expenses, capital income, dividends, profits from other property, private transfers, alimony, public transfers, child allowance, housing allowance, and educational grants. The taxes deducted are payroll tax, wealth tax and income tax. Social assistance and tax-free unemployment compensation are excluded. Though, even if the same definition is used in the surveys, the estimates are different, partly due to the tax reform implemented in 1992. However, this should have a small impact on the estimates and overall validity (Wider, 1999).

5.1 Criticism of secondary data sources

It is desirable to have an as comprehensive measure as possible, since, if neglecting particular types of income or expenditure then the results might get biased. On the other hand, the more comprehensive a measure is the greater the risk of incorporating variables that are potentially measured with error (Jenkins and van Kerm, 2009).

Atkinson and Brandolini (2001) have written an influential paper that discusses the use of secondary data in studies of income distribution. They show that the data choices affect both levels and trends in distributional data. The authors argue that within countries, consistent income distribution series over time do not necessarily exist, or there may be many different sources or different definitions used when gathering. This is partly because there is no consensus regarding the definition, methods and sources the gathered data might vary within countries, even if the data comes from the same source. Therefore, Atkinson and Brandolini (2001) suggest that one should strive to use observations that are as consistent as possible. When analyzing the top income earners, it is desirable to use series derived from taxation, since when using surveys often leads to under-sampling high earners. Also, taxation data allow one to study very small groups within the society. Despite the fact, the data gathered from the WIID2 contains top income shares that have been estimated from household surveys of post-tax income.[15] This might lead to measurement errors that spurs both from discrepancies between the measureable and the ideal, and from the measurable and reporting error. Though, the measurement error is endemic to all distribution studies, which makes it inevitable. Often, the reported incomes studied might not be the real incomes, but with the presumption that all individuals make the same reporting error (income is almost always underreported), this problem diminishes.

A last complication due to the fact that the analysis is based on household data is when using households as the statistical unit it means that all households are treated the same way, though households vary in composition and size, which implies that their needs are different. For example, a small household would have a higher standard of living from the same income as that received by a larger household, ceteris parabus. Costs of household members also vary according to their labor force status, student status, age and so on (Wider, 1999). The choice of time period over which the thesis wishes to measure the inequality is between 1960 and 2011. This might lead to a reduction in measured inequality, since transitory fluctuations are smoothened out, but are arguably presenting a more representative illustration of the situation. Despite the critique given, the WIID2 is still the most reliable and updated database and that is why this thesis use is throughout the paper.

[15] For more information regarding the interpolation of the Pareto-Lorenz coefficient see Atkinson et al. (2009) and the interpolation of income shares see Aaberge and Atkinson (2010) and Statistics Norway Research Department, Discussion Paper n.762

6 Methodology

In this chapter, the details and method applied in this study are presented. Various estimates and techniques have been used to analyse income inequality. The treatment of income inequality has passed from simple-factor tales, to decompositional accounting based on identities, to the use of regressions in order to weigh exogenous casual forces. The hypothesis of this thesis is that if a cointegration relationship is found between the variables, it means that top income shares can be used as a proxy for inequality when comparing them to the Gini-coefficient in times of crises. First a unit root test is conducted, to see the order of integration of my variables. Afterward, a cointegration test is applied following the Johansen approach, in order to find the long-term relationship. Finally, the Vector Error Correction (VEC) model is applied in order to establish what the precise relationship between the variables is. The methodology applied to the data employs standard time series econometric procedures and can be described as follows.[16]

6.1 Unit root test

The first step is to perform an ocular inspection of the secondary data from the WIID2 dataset in order to see if there are any structural breaks in the data. Afterwards, a unit root test is conducted to determine whether the variables are stationary or non-stationary. In stationary time series, shocks will be temporary and their effects will diminish in the long-term. Non-stationary time series will on the other hand contain permanent components. This leads to that the mean and/or variance of a non-stationary time series will depend on time, which is not wanted. Whilst various tests can be used, the preferred in this context is the Augmented Dickey-Fuller (ADF) test, since the test can be used even if the error term is not white noise (Asteriou and Hall, 2011).
Augmented Dickey-Fuller (ADF) regression model:

$$\Delta y_t = \gamma y_{t-1} + \sum \beta_i \Delta y_{t-i} + \varepsilon_t \quad (6.1)$$

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + \sum \beta_i \Delta y_{t-i} + \varepsilon_t \quad (6.2)$$

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + \alpha_2 t + \sum \beta_i \Delta y_{t-i} + \varepsilon_t \quad (6.3)$$

Where t is the time index, α is an intercept constant, ε is an independent, identically distributed (IID) residual, γ is the coefficient presenting process root, y is the variable of interest (top10, top5, top1, ipl). The aim of the test is to see if the coefficient γ equals zero, which implies that the process is non-stationary.

The null hypothesis for equation (6.1) is:
H_0: $\gamma=0$ y_t is non-stationary, against the alternative H_1: $\gamma<0$, y_t is stationary.
For equation (6.2) H_0: $\gamma=0$ $\alpha\neq0$, y_t is non-stationary, against H_1: $\gamma<0$ $\alpha\neq0$, y_t is level stationary. The null hypothesis for the third equation (6.3) is:
H_0: $\gamma=0$ $\alpha2\neq0$, y_t is non-stationary, and the alternative being H_1: $\gamma<0$ $\alpha2\neq0$, y_t is trend stationary.

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[16] More detailed descriptions of the data can be found in the appendix, i.e. the post-estimations tests conducted.

Equation (6.3) includes both trend and constant, while equation (6.2) only includes a constant and equation (6.1) excludes both trend and constant. It is important to specify correctly whether to include a trend or constant, since adding irrelevant restrictions into the regression may reduce the power of the test. In order to determine the correct lag length a correlogram will be inspected followed by the Akaike information criterion (AIC) and a testing down procedure where statistically insignificant lags will be removed (Asteriou and Hall, 2011).
When testing for number of unit roots (the order of integration) Doldado et al. (1990) suggest the following procedure:

1) Test y_t to see if it is stationary, if not differentiate y_t.
2) Test if first difference of y_t is stationary, if not take second differences.
3) Test if second difference of y_t is stationary, if not take third differences and continue until the right relationship is found.

The last step is to check if the residuals suffer from autocorrelation by using the Breusch-Godfrey test (Asteriou and Hall, 2011). In order to conduct a cointegration test, the variables need to be integrated of order one, I(1), meaning non-stationary in their levels and stationary in their first difference. If Y_t and X_t are cointegrated, the residuals, ε_t, are by definition I(0). If the variables do not cointegrate and the estimations are still conducted, there can be a problem of spurious regression (Asteriou and Hall, 2011).[17]

6.2 Multivariate Cointegration Model

Once the time series properties of the variables are known, the next step is to analyse whether there is an existing long-run relationship between them. Therefore, a Multivariate Cointegration Model is implemented in order to determine if the three selected groups are cointegrated with the inverted Pareto-Lorenz coefficient. If two (or more) series are each non-stationary, although a linear combination of them is stationary, then it can be said that the series are cointegrated.
The chosen model is the Vector Autoregressive (VAR) model, since it treats all variables as endogenous and it allows one to estimate each equation separately with a usual OLS method. General VAR model:

$$y_t = \alpha_0 + \sum A_j y_{t-j} + \varepsilon_t \qquad (6.4)$$

Where y_t is the variable (top10, top5 top1, ipl). α_0 is the constant, A_j is the matrix of VAR parameters for lag j and ε_t is the vector of error terms. Though, some criticism towards the VAR model is that it is atheoretic (not based on an economic theory) since one could say that 'everything causes everything'. Thus, when put in a context it is a very effective tool. A second criticism regards the loss of freedom. If the sample size is not sufficiently large the estimation of numerous parameters will consume many degrees of freedom, creating problems in the estimation. Prior to the specification of the parsimonious VAR model, one needs to decide the number of lags to include. Too many lags could increase the errors in the prediction, and too few could leave out important information (Asteriou and Hall, 2011; Adkins and Hill, 2008).

[17] Spurious regression occurs when variables have no causal relationship, yet it may be wrongly inferred that they do.

6.2.1 The Johansen approach

Once the lag length of the VAR is determined and the order of integration of the series is known, the Johansen approach is implemented in order to test for cointegration.
The approach relies on the relationship of the rank of a matrix and its characteristic roots. The main reason to use the Johansen multivariate cointegration (and not the Engle-Granger approach) is because it allows for multiple relationships. Accordingly, the Patula principle is followed to determine the specification of the test:

Model 1: $\delta_1 = \delta_2 = \mu_1 = \mu_2 = 0$; No deterministic component in the data or in the cointegrating equation (CE). (This is very unlikely to occur in practice).
Model 2: $\delta_1 = \delta_2 = \mu_2 = 0$; A deterministic trend or intercept in VAR, although intercept in CE.
Model 3: $\delta_1 = \delta_2 = 0$; Intercept in VAR and CE, but no trends.
Model 4: $\delta_2 = 0$; Intercept in VAR and intercept and linear trend in CE.
Model 5: Intercept and quadratic trend in the CE, intercept and linear trend in VAR. Everything is unrestricted. (This model is rarely used, since it is very difficult to interpret from an economic point of view). Since model one and five are unlikely to occur the estimations start with model two and ends with model four.

The hypothesis of the Johansen approach:

Model 2:
H_0: No cointegration relationship
H_1: At least one cointegration relationship
- If H0 is rejected, continue testing with

Model 3:
H_0: At most 1 cointegration relationship
H_1: At least two relationships
- If H0 is rejected, proceed to

Model 4:
H_0: At most two cointegration relationship
H_1: At least three relationships
- Continue like this until the right relationship is found

The model selection procedure is by moving from the most restrictive to the least restrictive and comparing trace statistics to the critical value at each step. The right model is found when it is concluded that the null hypothesis is not rejected for the first time (Asteriou and Hall, 2011).

6.3 Vector Error Correction model

When one or more cointegration relationships are found, the Vector error correction (VEC) model enables one to identify the dynamic long-run and short-run relationship between the variables. The VEC model takes any cointegration relationship into account. This model is chosen since the variables are not stationary in their levels, but are in their differences.

The VEC model is estimated in the same way as a VAR of stationary first differences by adding a lagged residual from an auxiliary regression as an independent variable. The general model:

$$\Delta Y_t = \sum \Gamma_j \Delta Y_{t-j} + \alpha\beta' Y_{t-k} + \mu + \varepsilon_t \qquad (6.5)$$

Where $\sum \Gamma_j \Delta Y_{t-j}$ and $\alpha\beta' Y_{t-k}$ are the error-correction components and vector autoregressive component in first differences. In levels of equation (6.5) Y_t is a p*1 vector of variables and is integrated of order one. μ is a p*1 vector of constants and is the lag structure. ε_t is a p*1 vector of white noise error terms. Γ_j shows the short-run effect and measures the immidiate effect a change in X_t will have on a change in Y_t. α is the speed of adjustment representing the time it takes for the variable to adjust back to the long-term equilibrium after a shock. A large α suggest a faster convergence toward long-term equilibrium (Maysami and Koh, 1998).

Hence, the VEC model can only be used if the variables are cointegrated. The procedure for selecting the correct number of lags to include in the Augmented Dickey-Fuller test is the same as for a VAR, which is described above in section 6.1 and 6.2. Once again, the smallest ADF model without autocorrelation in the residuals will be chosen (Adkins and Hill, 2008). In this thesis the VEC model will be used to analyse the long-run relationship between the top income shares and the inverted Pareto-Lorenz coefficient in order to see if relative inequality have a positive or negative impact on top income shares.

7 Empirical Results

This chapter presents the results following the method presented in the previous chapter. The unit root test concluded that the variables were non-stationary in levels and stationary in first difference. Meaning that the variables were integrated of order one, I(1) and thereby could proceed with the cointegration test. The main findings from the test showed that there was one cointegration relationship among the variables. The Vector error correction model showed that the variables were mutually dependent in the short-run and the long-rung estimates showed that top ten and top one income shares affected the inverted Pareto-Lorenz coefficient positively (indicating a rise in concentration). However the five percent income share had a negative impact on inequality, indicating a decline in inequality. The post-estimation tests showed signs of skewness, non-normality and kurtosis mainly in the top 5 variable.

7.1 Descriptive statistics

Table 7.1 displays the three top income share groups and the inverted Pareto-Lorenz (IPL). It shows the mean value, standard deviation, maximum and minimum value and the number of observations. It is evident that the top income shares and the inverted Pareto-Lorenz are rather smooth (not having a very high standard deviation) and there is therefore no need to logarithm when conducting the tests.

Variable	Mean	Standard deviation	Number of observations	Minimum	Maximum
Top 10	27.92	3.28	52	21.83	37.06
Top 5	17.78	2.75	52	13.17	28.13
Top 1	6.57	2.26	52	4.13	16.49
IPL	1.80	0.49	52	1.38	3.33

Table 7.1: Descriptive statistics of the time series
Source: (Authors' own compilation, 2014)

7.2 Unit root test

The ocular inspection of the series shows that there is a structural break in the series (between 2005-2006), though since the time period is 51 years, the effect will be reduced and probably not affect the overall results.

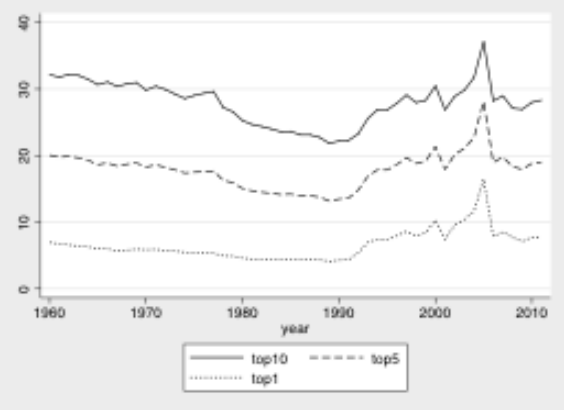

Figure 7.1: Top income shares, in levels

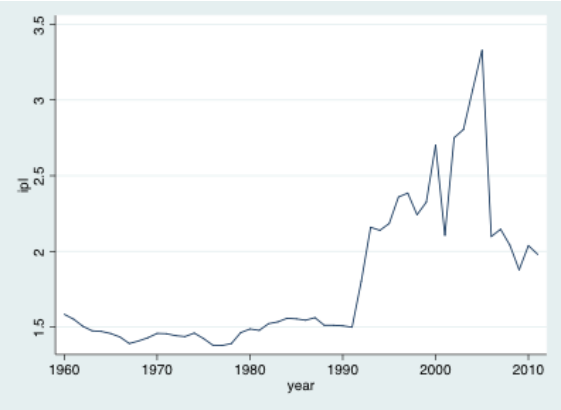

Figure 7.2: Inverted Pareto-Lorenz, in levels

Note: Top incomes measured in percentages and inverted Pareto-Lorenz coefficient as an index
Source: (Authors' own compilation, 2014)

After performing an ocular inspection of the series in their levels, the data did not seem to fulfil the properties of stationarity.[18] Therefore, the data was differentiated following the method in 6.1.

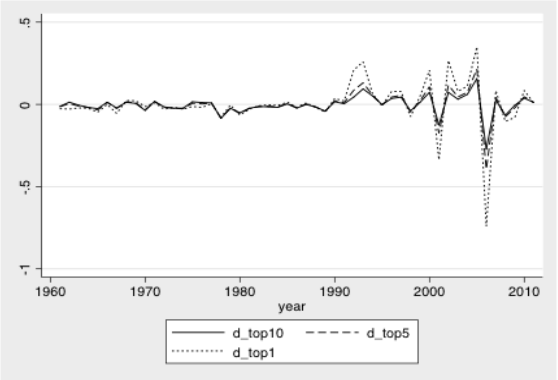

Figure 7.3: Top income shares, in 1rst difference

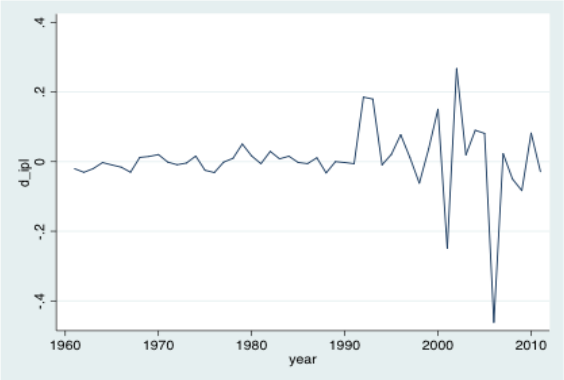

Figure 7.4: IPL, in 1rst difference

Source: (Authors' own compilation, 2014)

When plotting the series in first difference they seem to fulfil the properties of stationarity. However, the Augmented Dickey-Fuller (ADF) test needs to be employed to determine whether this is accurate.

Variable	Lags	No. Obs.	Test statistic	5% critical value	Specification	Conclusion
top10	0	51	-2.241	-2.929	Constant, no trend	Cannot reject H_0
top5	1	50	-1.733	-2.930	Constant, no trend	Cannot reject H_0
top1	0	51	-2.568	-2.929	Constant, no trend	Cannot reject H_0
IPL	0	51	-2.741	-3.499	Constant & Trend	Cannot reject H_0

Table 7.2: ADF test, in levels

Source: (Authors' own compilation, 2014)

[18] That the mean and/or variance do not depend on time, or change over time.

As can be seen from table 7.2, the null hypothesis of a unit root cannot be rejected and the residuals do not seem to suffer from autocorrelation.[19] Though, completely opposite findings where obtained when conducting the same tests with differentiated time series.

Variable	Lags	No. Obs.	Test statistic	5% critical value	Specification	Conclusion
d_top10	0	50	-8.980	-1.950	No constant & no trend	Reject H_0
d_top5	0	50	-9.380	-1.950	No constant & no trend	Reject H_0
d_top1	0	50	-9.545	-1.950	No constant & no trend	Reject H_0
d_IPL	0	50	-8.699	-1.950	No constant & no trend	Reject H_0

Table 7.3: ADF test, in first difference

Source: (Authors' own compilation, 2014)

Table 7.3 suggest that the null hypothesis can be rejected, indicating that the time series now are stationary. Since all the series are non-stationary in their levels, but stationary in the first difference, I can conclude that all the time series are integrated of order one, I(1).

7.3 Cointegration

As suggested by the Akaike Information Criteria (AIC), the VAR model with one lag was used when testing for cointegration. In order to find a parsimonious model, the Pantula principle is followed, starting with the most restrictive model (model 2) to the least restrictive (model 4). Table 7.4 present the results from the three estimated models.

Model:		**Model 2**		**Model 3**		**Model 4**	
H_0	**H_1**	**Trace**	**5%**	**Trace**	**5%**	**Trace**	**5%**
None	**At least 1**	86.82	53.12	82.13	47.21	93.50	62.99
At most 1	**At least 2**	**31.44***	**34.91**	**26.75***	**29.68**	**37.33***	**42.44**
At most 2	**At least 3**	18.09	22.72	14.71	15.41	18.85	25.32

Table 7.4: Results from cointegration test

Source: (Authors' own compilation, 2014)

When following the Pantula principle, the trace statistics were compared with the critical values, stopping only when the null hypothesis is not rejected for the first time. The results show that the null hypothesis of no cointegration relationship against the alternative of at most one cointegration relationship among the time series was rejected for all the models tested. Although, when testing for at most one cointegration relationship against the alternative at least two cointegration relationships among the series, the null hypothesis could not be rejected for any of the models at a 5 percent significance level. This implies that one cointegration relationship is found among the variables. Although, the test does not indicate between which variables the cointegration relationship is, it only states that at least two series are integrated over time.

[19] The results from the Breusch-Godfrey test is found in the appendix

7.4 Vector error correction model

The Vector error correction (VEC) model was conducted in order to see the dynamic short-run and long-run relationship between the variables. As suggested by the pre-estimation tests, the model was tested with one lag and of rank one. The short-run (α) relationship is presented in table 7.5 and the long-run (β) relationship in 7.6.

Sample: 1960-2011
Number of observations: 51

Variable	Coefficient	Std. Err.	P>z
d_IPL	1.38	0.18	0.000
d_top10	10.16	1.35	0.000
d_top5	10.42	1.24	0.000
d_top1	9.67	1.04	0.000

Table 7.5: Short-run relationship between top10, top5, top1 and IPL
Source: (Authors' own compilation, 2014)

Table 7.5 show the short-run relationship between the variables and display a mutual dependence. When chocked from the equilibrium, the speed of adjustment is 1.38 for the inverted Pareto-Lorenz coefficient and around 10 for the top income shares. A high speed of adjustment indicates that the top income shares converge fast to the long-term equilibrium after a shock. The constants were not significant for any of the variables and are thus not included in the table.

Beta	Coefficient	Std.Err.	P>z
IPL	1	.	.
top10	-0.13	0.05	0.012
top5	0.40	0.10	0.000
top1	-0.54	0.67	0.000
constant	-1.80	.	.

Table 7.6: Long-run relationship between top10, top5, top1 and IPL
Source: (Authors' own compilation, 2014)

The β is the coefficient of interest, since it shows the interplay in the long-term. The estimation in table 7.6 has normalised the inverted Pareto-Lorenz and is demonstrated by the equation:

$$IPL = 1.8 + 0.13top10 + 0.54top1 - 0.40top5 + \varepsilon_t \quad (7.2)$$

Equation (7.2) indicates that both top ten income share and top one income share have a positive impact on the inverted Pareto-Lorenz, hence increasing the concentration in the top and the inequality. The top five income share has a negative, indicating a decline in inequality. Equation (7.2) could also be interpreted as: If the inverted Pareto-Lorenz increases by one unit, the top ten income share increases by 0.13 percent, the top one income share increases with 0.54 percent and the top five decreases with 0.40 percent.
The post-estimation tests from an overall Jarque-Bera statistics showed that the results suffered from non-normality, skewness and kurtosis, but not from autocorrelation (showed by the

Lagrange-multiplier). The kurtosis and skewness was mainly due to problems in the top five variable.[20]

[20] See appendix.

8 Analysis and Discussion

This chapter will discuss the empirical findings presented in the preceding chapter, and answer the question whether the top income shares are a good proxy for inequality based on the cointegration test presented in 7.4. Then section 8.1.1 and 8.1.2 will focus on the secondary objective of the thesis by presenting and reflecting upon how top income shares and the Gini coefficient developed during the banking crisis and the financial crisis. The conclusion is that the income shares can be used as a proxy for inequality. The main finding when analysing the banking crisis is that it did not seem to have affected top income shares. The period of the financial crisis showed a relative stable rising pattern, if the peak in 2005 is disregarded. Overall, the top income shares, Gini coefficient and inverted Pareto-Lorenz seems to be more affected by the tax reform in 1992 and the tax on dividends in 2006, than by the crises examined in this thesis.

8.1 Top income shares as a proxy for inequality

The results demonstrated in table 7.4 indicated that at most one cointegration relationship and at least two cointegration relationships were present among the time series. Intuitively, given the results from Leighs' (2007) paper, at least one, if not three cointegration relationships were to be expected. Though, the cointegration found could indicate that the relationship is between the top income shares and not between the top income shares and the inverted Pareto-Lorenz coefficient. The results from the VEC model in table 7.5 showed that the variables were mutually dependent in the short-run and had a short speed of adjustment period. The results imply that if the variables are shocked, it does not take the top income shares to adjust back to their long-term equilibrium.

The results from the table 7.6 revealed the long-run relationship. The coefficient of interest is the "Beta", where the inverted Pareto-Lorenz coefficient has been normalized. Overall it shows that top ten and top one income shares increases inequality and a shock to top five income shares will decrease inequality. Though, when conducting the post-estimation test, the variable "top5" indicated some problems with kurtosis, non-normality and skewness, whereas the remaining sample showed signs of robust results. One possible explanation to why the "top5" is not robust, is due to a misspecification in the model. In order to correct for the problems with variable "top5", a dummy variable could be imposed for the extreme values. This was however not corrected for, since the main aim was to find a cointegration relationship and the VEC test was mainly conducted to investigate if the top income decile were heterogeneous, as pointed out by Waldenström (2009) and Piketty (2003). The sample tested in this thesis, and graph 8.1 show that the chosen groups follow a similar pattern, indicating that the top decile in Norway appears to be rather homogenous, even though the top 0.5 or 0.1 where included. Therefore, this thesis cannot conclude whether those groups follow a similar pattern and thereby stipulate a less homogenous decile in Norway.

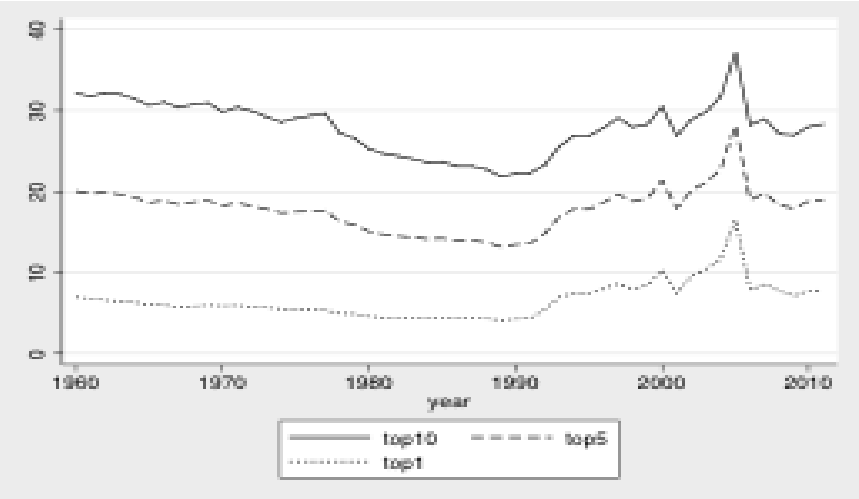

Figure 8.1: Graph of top income shares in Norway, 1960-2011
Source: (Authors' own compilation, 2014)

The time period was set in order to see whether the entry of oil into the Norwegian economy had an impact on inequality. As we see in figure 8.1 the top income shares started increasing after the 1990s, which may be related to the oil fortunes being built up during the years and also because of the rise in world stock markets prices that led to a rise in the top shares in other countries as well. The first notable small peak around 1997 could perhaps be explained by a change in the Norwegian tax laws specifying an increase in the assessed values of corporate stock on personal tax returns (Waldenström, 2009). The small decline in top income shares around 2001 could be explained by a temporary tax on dividends, whereas the implementation of a permanent dividend tax in 2006 gave strong reasons for owner-managers of closely held firms to increase dividends in 2005, which lead to an increase in top income shares (Aaberge and Atkinson, 2010). Though, as one can see, income shares amongst the top decile has been stable in the long rung, with the exception of the years 2005-2006.

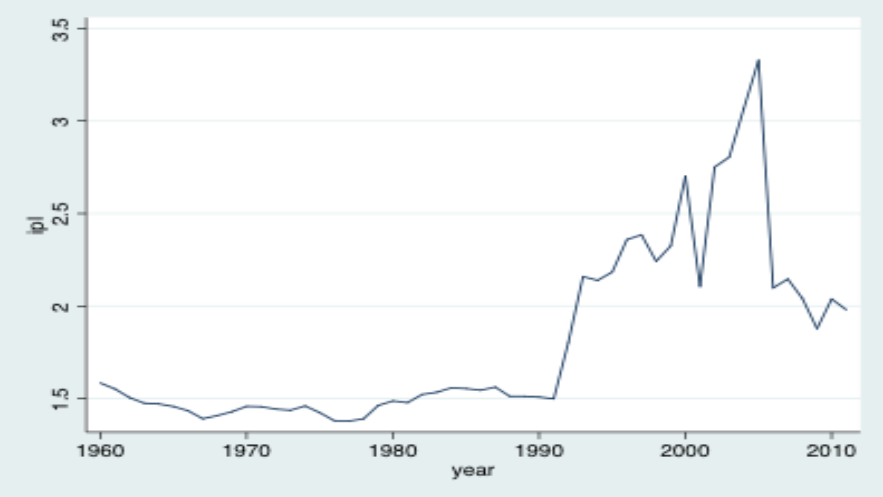

Figure 8.2: Graph showing the inverted Pareto-Lorenz coefficient, 1960-2011
Note: Coefficient based on share of 1 in 10.
Source: (Authors' own compilation, 2014)

Graph 8.2 demonstrate that the inverted Pareto-Lorenz was low and stable until the banking crises in 1991-1992. After the banking crises there was a growing concentration of top income earners in Norway. Still, the big spike in 2005 is probably due to the temporary tax on dividends, which increased the inequality with 75 percent. The inverted Pareto-Lorenz then decreased by

the same percentage the following year. In the following two sections the focus will specifically be on the years when the banking crisis and the financial crisis occurred. Therefore, the graphs presented (8.3 and 8.4) only display the years between 1990 and 2011.

8.1.1 The banking crisis

Atkinson and Morelli (2011) showed that banking crises were preceded by falling inequality as often as by rising inequality, and in some cases the inequality remained stable. Before looking into figure 8.3 we need to see the overall picture in figure 8.1, in which we can distinguish a small downward sloping pattern in top income shares in the years prior to the banking crises is 1991-1992. This indicates that the inequality also was decreasing during this time period.

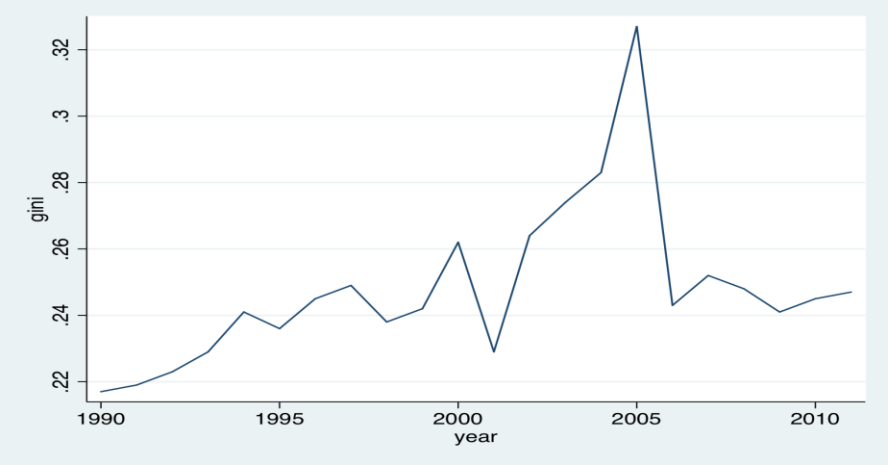

Figure 8.3: Graph showing the Gini coefficient, 1990-2011
Source: (Authors' own compilation, 2014)

The graph 8.3 shows the Gini coefficient after the banking crisis was a fact. Since then, relative inequality steadily increased in Norway and reached a first peak in 1994. This was the time when the Government Bank Insurance Fund had been implemented and banks started regaining confidence. The top income shares, plotted in figure 8.4, did not develop in a similar trend during this time period. They had a much smoother rise and peaked first in 2000. Yet, theory is ambiguous regarding whether high levels of inequality results in crises or whether a crisis cause a rise in inequality. When analysing the data used in this thesis, it is hard to distinguish a pattern of which one followed the other in Norway, since the top income shares did not seem to be affected at all. Perhaps the fluctuations in the top income shares where smoothened out by the fast and effective measurements taken by the government.

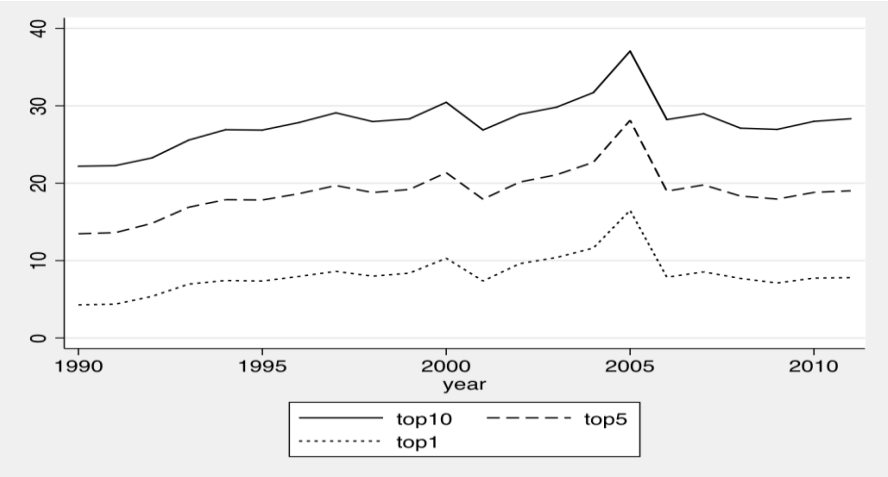

Figure 8.4: Graph displaying top income shares, 1990-2011
Source: (Authors' own compilation, 2014)

Previous research showed that the groups that gained most after the banking crisis was the top one percent. Aaberge and Atkinson (2010) showed that the share of the top one percent income share rose approximately seven percent between 1991 and 2004. The findings from figure 8.4 seem to be in line with Aaberge and Atkinson's (2010) result regarding the share of the top one. Though, the share of the top five percent seem to have increased even more, with 12 percent during the same time period. Even though Aaberge and Atkinson (2010) did not find any increase in the top ten, figure 8.4 shows that the group experienced a increase of approximately ten percent. The different results could be due to the use of different datasets or definitions. Perhaps a different scenario would have been able to distinguish if the graph was displaying the overall wealth (by including the capital gains as well) instead of only the income shares.

8.1.2 The financial crisis

This section takes into account Atkinson and Morelli's (2011) findings, mainly with regard to whether a "classic Λ-shaped pattern" is prevalent or not. Two Λ-shapes are apparent in both figure 8.3 and figure 8.4. The first is a smaller peak in 2000 and then there is a second, bigger peak in 2005. The second Λ-shape occurs two years prior to the financial crisis and can thereby not be associated with the crisis. During 2006-2011 the top income shares did not seem to be affected by the crisis. However, the overall results are in line with Atkinson and Morellis' (2014) theory, since the inequality does not necessarily rise or decline in the period prior to the crisis. The Gini coefficient indicates a rather different pattern. In 2006, after the implementation of the dividend tax, the inequality decreased to a level compareable to 1998, then it increased from 0.24 to 0.25 in 2007 where it peaked. A decline followed the next two years and then the graph indicates an upword slope until 2011. Although, one need to keep in mind that the peaks in 2005 and 2007 seem to be larger than they would have been if the entire scale had been plotted (ranging from zero to one).

In general, the banking crisis and the financial crisis seem to be a small part of the story regarding inequality in Norway. Rather, the possible explanations to the fluctuations is found in Aaberge and Atkinsons' (2010) and in Grytten and Hunnes' (2010) paper, describing the tax reform in 1992 that included a significant reduction in taxes on capital incomes. The rising trend in top income shares from 1992 and onwards can thereby be explained by capital gains and dividends among the richest households. The temporary decline in income shares in 2001 could be a result of a temporary tax on dividends, and the implementation of a permanent dividend tax in 2006,

which motivated the owner-managers of closely held firms to increase dividends in 2005. As we can identify by graph 8.4 and the findings from Aaberge and Atkinson's paper the dividends were well above what might be considered as normal during this time period. The differences in findings between this thesis and Atkinson and Morelli (2011) could be due to the use of another dataset, with another definition of income. Though, it could also be because of different methods used when extrapolating the incomes. Perhaps other results would have been found if the data used in this thesis were pre-tax income, instead of disposable income.

9 Conclusion

Over the last decades, economic inequality in general, and income inequality in particular have showed rising trends in developed economies. Norway is considered to be one of the world's most equal countries and even if the incomes are relatively equally distributed and the mobility among generations are high, growing inequality can lead to bigger societal problem. Piketty (2003), Atkinson (2008) and Atkinson and Morelli (2011) show evidence of an increasing inequality in the last decades. A large part of the literature presented is concerned with progressive taxation and even a global tax in order to deal with the worries of a rising inequality. Though, rising inequality is not only negative, Castells-Quintana and Royueal (2014) discuss some positive aspects, such as higher aggregated saving, which leads to a higher level of investment and growth for a country.

Norway was not left unaffected by the banking crisis and financial crisis. Grytten and Hunnes (2010) findings show that the crises had a large impact on the house market and stock market. Knutsen (2012) claims that the triggering cause of the financial crisis was the large drop in oil prices during 1985-1986, in combination with the stock market crash on Wall Street. In addition, Alstadsæter and Fjærli (2009) presented another important occurrence that affected the top income earners, namely the Norwegian shareholder income tax that was announced in 2005 and implemented in 2006. Furthermore, Atkinson and Morelli (2011) show that a crisis can either be preceded with rising inequality and then followed by falling inequality or by declining inequality at first, followed by rising inequality after the crisis. As presented in this thesis none of the two possible outcomes developed in Norway.

Income inequality is a complex subject. This thesis has analysed if the top income shares can be used as a proxy for inequality, by finding a cointegration relationship between the top income shares and the inverted Pareto-Lorenz coefficient. This was investigated since Leigh (2007) showed that the top income shares and the Gini coefficient were correlated, and top income shares could therefore be used as a proxy for inequality. The methodology used to find the long-term relationship was the Johansen approach, following the Pantula principle. Since one cointegration relationship was found, and with regard to research conducted by Leigh (2007) this thesis used top income shares as a proxy for inequality. Despite the fact that a cointegration relationship was found, there is a possibility that the relationship only where between the three top income groups. Since the top one and top five income shares are included in the top ten income shares. The ideal would have been if at least three cointegration relationships were found. Subsequently, the Vector Error Correction model was used to test whether the chosen groups affected or where affected by the inverted Pareto-Lorenz coefficient. The results showed that top ten income shares and top one income share had a positive effect and that top five had a negative impact on the Pareto-Lorenz coefficient. However, nothing can be said about the causal relationship between the variables. The second objective was to analyse the development of three different indices - the inverted Pareto-Lorenz, the Gini coefficient and the top income shares in order to graphically examine how inequality evolves during times of crises. The findings indicate that the banking crisis and the financial crisis did not affect inequality substantially. The largest changes in top income shares seems to be due to the tax reform in 1992 and the implementation of the dividend tax in 2006, which is beyond the scope of this thesis.

Perhaps future research could answer the question regarding the development of income inequality when major tax reforms are implemented. The research could be expanded to include

the bottom of the distribution as well, in order to see the overall inequality. Another possibility could be to focus specifically on the role of inequality and growth to try to find the causal relationship between the two variables. By including more explanatory variables such as investments, change of government or the impact of globalisation. Furthermore, it would be advisable to perform similar research as the one presented, but indentifying a relationship between top income shares and the Gini coefficient over a longer time period, by including the entire twentieth century and perhaps include all the Nordic countries.

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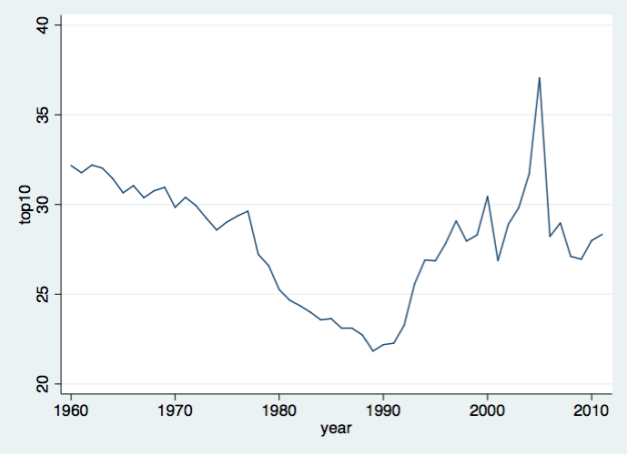
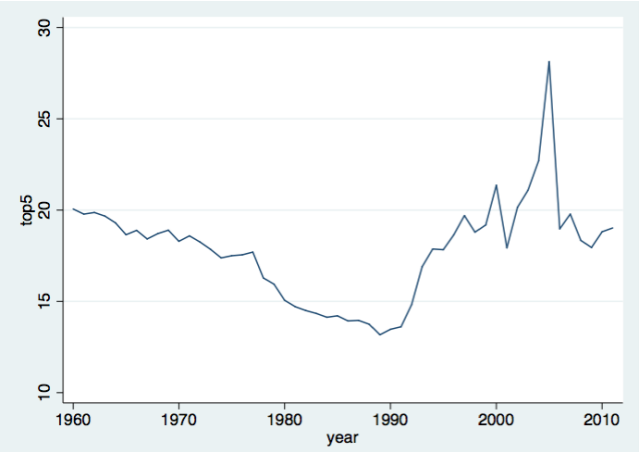
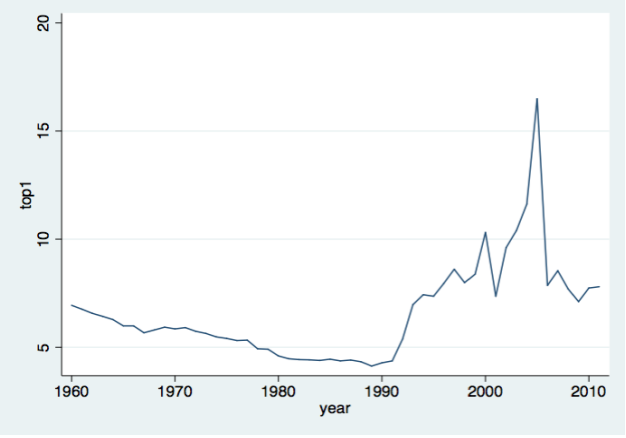
11 Appendix

Time period: 1960-2011

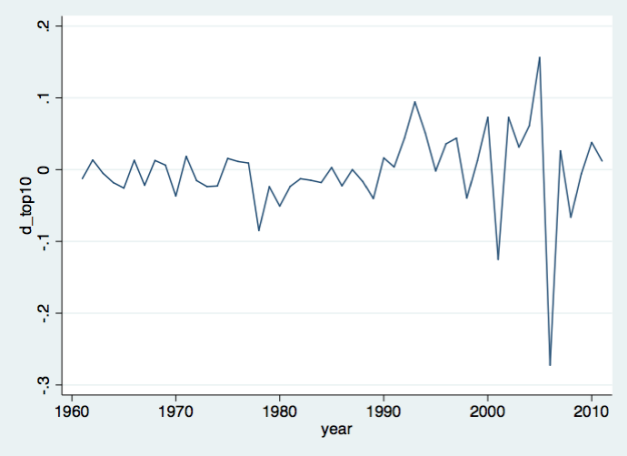
Top X% income share, in levels

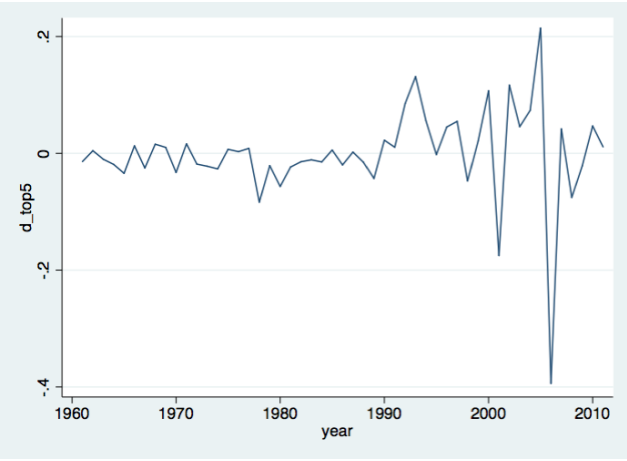


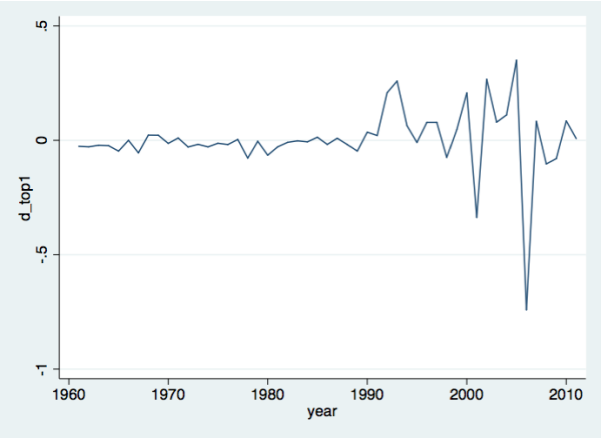


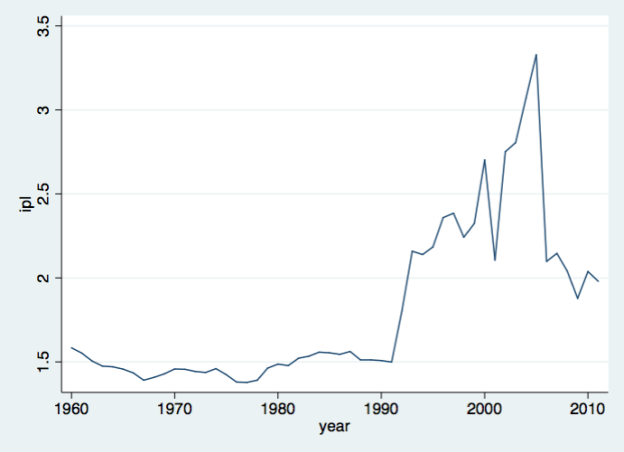


Top X% income share, 1rst difference

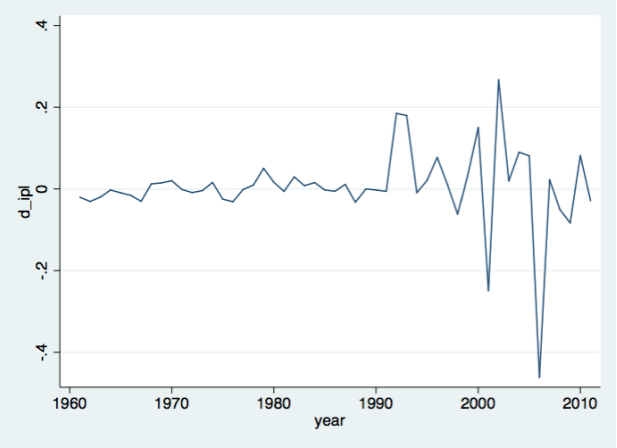








Inverted Pareto-Lorenz, in levels



Inverted Pareto Lorenz, 1rst difference

Post-estimation tests (1960-2011):

Breusch-Godfrey test for autocorrelation, in levels

Lags	top10	top5	top1	ipl
1	0.0853	0.0494	0.0291	0.1291
2	0.2233	0.1449	0.0843	0.3154
3	0.3436	0.2084	0.1294	0.2808
4	0.1391	0.1045	0.0634	0.0809
5	0.1666	0.1258	0.0930	0.0948
6	0.2371	0.1685	0.1270	0.0909
7	0.3305	0.2461	0.1878	0.1419
8	0.4084	0.3129	0.2453	0.2053
9	0.4693	0.3185	0.0380	0.1410
10	0.3508	0.1476	0.0187	0.1965

H_0: Autocorrelation

H_1: No autocorrelation

Breusch-Godfrey test for autocorrelation, first difference

Lags	d_top10	d_top5	d_top1	d_ipl
1	0.7407	0.8456	0.9683	0.8819
2	0.8294	0.6874	0.4840	0.5069
3	0.7900	0.4645	0.3160	0.6927
4	0.4389	0.4023	0.2991	0.2315
5	0.3062	0.2801	0.2302	0.2355
6	0.4207	0.3927	0.3194	0.1563
7	0.5278	0.4953	0.4014	0.2112
8	0.5996	0.5725	0.5051	0.2927
9	0.6599	0.6226	0.4824	0.3170
10	0.6765	0.5909	0.4340	0.3958

Order selection criteria when selecting lag length in VAR model:

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-147.523				0.006487	6.31346	6.37239	6.46939
1	43.4304	381.91	16	0.000	4.4e-06*	-0.976265*	-0.681628*	-0.196598*
2	59.005	31.149	16	0.013	4.6e-06	-0.958543	-0.428196	0.444858
3	72.0314	26.053	16	0.053	5.4e-06	-0.834643	-0.68586	1.19249
4	87.7765	31.49*	16	0.012	5.9e-06	-0.824021	0.177746	1.82685

Post-estimation tests:

Normality test

Jarque-Bera Test	Prob>chi2
d_ipl	0.00039
d_top10	0.00652
d_top5	0.00000
d_top1	0.08949
ALL	0.00000

H_0: No Normality
H_1: Normality

Skewness	Prob>chi2
d_ipl	0.93801
d_top10	0.83668
d_top5	0.00001
d_top1	0.30798
ALL	0.00027

H_0: No Skewness
H_1: Skewness

Kurtosis	Prob>chi2
d_ipl	0.00007
d_top10	0.00155
d_top5	0.00000
d_top1	0.05162
ALL	0.00000

H_0: No Kurtosis
H_1: Kurtosis

Lagrange-multiplier test

lag	Prob>chi2
1	0.40166
2	0.17903
3	0.29992
4	0.25947
5	0.00356
6	0.61845
7	0.06714
8	0.43871
9	0.30694
10	0.59187

H_0: No autocorrelation
H_1: Autocorrelation